Information Technology and Urban Form: Challenges to Smart Growth

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Introduction

Place, the community-region, and globalization are a trilogy in the current policy discourse involving information technology (IT) and urban form. In an era of time-space compression and national-to-local devolution of power, jurisdictions at all levels in the New Economy[1] increasingly compete for knowledge workers and investment. Urban analysts of information technology from a variety of theoretical perspectives (Castells 1996(a), Graham and Marvin 1996, Storper 1997, Hall 1997, Mitchell 2000, Richard Florida 2000, Kotkin and DeVol 2000) repeatedly tell us three things: (1) that we are experiencing a shift to a new type of knowledge economy, in which intellectual capital is rapidly replacing other forms of capital in the generation of wealth; (2) that understanding where in the metropolitan region the new breed of knowledge and high-tech workers want to live, work, and play is fundamental to the geography of the New Economy and (3) that designing quality places that attract elite-tech workers can protect the local community from globalization's ravages, such as deindustrialization, cross-geographic arbitrage, and other vicissitudes of our newfangled digital age.

[1] Some policy analysts have coined the term "E-conomy" to connote the profound structural trans-formations associated with information technology, which are not only affecting one sector of the economy but the entire economy and the society on which it rests (Cohen et al. 2000). This is the sense that this paper imparts to the "New Economy" concept, primarily as used in the urban restructuring perspective.

This paper raises two questions: what conclusions can be gleaned from research about the urban form effects of information technology? And with what implications for Smart Growth? Since research findings are seldom conclusive, particularly on a subject as dynamic and volatile as telecommunications and information technology, answers to these questions must remain tentative. However, there is an emerging research consensus regarding IT and urban form effects that raises important issues for Smart Growth policy.

Smart Growth, Sprawl, and the Urban Form of the Information Age

Concurrently, movements such as Smart Growth, the Congress for the New Urbanism, New-Economy Towns, Livable Communities, New Regionalism, and a flurry of e-networked civic coalitions are emblematic of (a) growth management and urban design manifestos attempting to come to grips with new sociospatial realities besieging urban life and the economic future of cities, and regions in the information age, and (b) new powerful organizational and networking competencies enabled by the information revolution, which Manuel Castells (1996a) asserts to be fundamentally new expressions of the current "network society." As a result, new regional coalitions between local governments, educational institutions, e-entrepreneurs, the IT industry, community developers, planners and urban designers have come together to reinvent locales as more livable, sustainable and vibrant world-class digitally connected communities. The rallying cry of these coalitions is often a

denunciation of the oppressiveness of urban sprawl, perceived as long commutes, traffic gridlock, fast disappearing open space, environmental pollution, and mass-produced uniform development patterns.

Paradoxically, the literature and research that examine the spatial synergies among IT and transportation, organizational change, and economic development seem to indicate that the emerging urban form of the New (Space) Economy is spatially more loose and fragmented, dynamically more polycentric and complex, and fast dispersing and reconcentrating at the urban edge. Hence, in the absence of effective models of regional governance and planning, urban growth in the New Economy may result in the furtherance of urban sprawl, understood as more exurban development, social and spatial segregation, and traffic gridlock.

Research in Information Technology and Urban Form

Research dealing with the urban form implications of information and communications technology is conceptually dominated by two schools of thought: the urban **deconcentration** and **restructuring** schools (Frey 1993, Audirac 2002a). Although both schools identify the tension between *decentralizing* and *centralizing* forces shaping urban form, they differ in their scale of analysis and in the way they theorize IT and telecommunications. The deconcentration tradition assigns causality to firms and consumer preference, and focuses on explaining and predicting intrametropolitan urban-form effects,

through the use of preference surveys and spatial interaction and discrete choice models. The restructuring tradition, on the other hand, assigns causal weight to factors such as government, corporate, and institutional agents and emphasizes policy analysis and cross-national and regional comparisons via descriptive case studies.

In the deconcentration tradition, instant communications reduce the cost of travel and stimulate the outward growth of cities as firms and households are able to move to the periphery. At the same time, however, this trend raises the need for control and coordination of dispersed operations, which in turn increases the need to reconcetrate specialized managerial activities at strategic sites (Hawley 1986). Since the 1970s, geographers have argued that electronic communications break the tension between centralization and decentralization in favor of decentralized polycentric settlement patterns characterized by high growth in the information services sector (Berry 1973). As new technologies increasingly substitute for face-to-face interaction, some in this school speculated that core-oriented cities could eventually dissolve into an urban civilization without cities, but instead, research has shown that rather than disappearing, cities have evolved into complex polycentric urban structures.

In the restructuring school, the political economy of cities in a globalizing era takes center stage. Since theories in this school are vastly heterogeneous, it can simply be said that they emphasize economic and spatial restructuring resulting from: (a) technological change that is part and parcel of new (capitalist)

economic processes, and (b) the role that the public sector plays in shaping the conditions for economic growth (capital accumulation).

Spatially, cities are the focus of the local-global interplay of a new mode of capitalist development labeled "informational" by Castells (1996a), because it is reorganized for the production of information technology and devices (hardware and software) and for the creation and processing of information. Geographically, this new mode of development is global and for the first time in history digitally connected on a real-time basis. Telecommunications and IT advances have made possible the ease of worldwide information flows through a digital superstructure or global lattice linking cities and regions across the world; Castells calls this global lattice the "space of flows." Successful cities and firms in the informational era are those that can tap into global production networks such as global supply and production chains and become important global nodes. For instance, New York, Tokyo and London are dominant nodes in global financial flows. San Jose, California, Bangalore, India, Timisoara, Romania, Guadalajara, Mexico, and Suzhou, China are nodes in networks of electronics production (Audirac 2002b). However, one well known downside of the global informational economy is that the application of new information technologies to routinizable manufacturing operations and services has facilitated their flexible relocation anywhere in the world where transaction costs are cheaper. This has occurred either domestically at the urban periphery in edge cities and beyond, down the urban hierarchy in 2nd and 3rd tier cities, or internationally in off shore

regions. Sassen (1994) argues that precisely the need to coordinate the dispersion of manufacturing and data processing operations throughout the world has given rise to global cities as specialized global control centers of the world economy. However, the remaining cities are said to be increasingly the object of cross-geographic arbitrage, whereby top global companies (i.e., multinational corporations) take advantage of varying cost and productivity across nations.

Capital mobility, liberalized markets, and digital technologies that shrink the costs of distance have unleashed cut-throat competition among companies for cross-geographic economies and a race among cities for shares of global capital. Winners according to Michael Storper (1997) will be those cities and regions, which can learn faster and keep innovating or creating knowledge that cannot be readily imitated, standardized or routinized and relocated to competitor nations and regions. Cities that attract and retain the R&D and innovation functions of companies, known as industry shapers like Microsoft or Intel, are less prone to be subjected to geographic arbitrage.

Urban Forms of the Information Age

Urban forms in the New Economy, according to Castells (1996a), are defined by three interrelated supporting layers of "the space of flows," which include: (1) the cities forming part of a global network of production, financial, managerial, drug trafficking, etc; (2) the technological infrastructure (e.g., fiber optic, satellite, and telecommunications networks and intermodal logistics

systems) that form the digital and fast communications lattice connecting these cities (very much like railways defined economic regions in the industrial era); and (3) the places valued by the information-age elite (e.g., knowledge workers, and the New Economy's managerial and high-tech elite). Outside these urban forms or "space of flows" lie the urban underclass and information-age-have-nots, whose labor is superfluous to the New Economy. Exacerbating the central-city-suburban spatial mismatch characteristic of the automobile society (see Shen 1999, OTA 1995), these groups are typically excluded and spatially segregated by real estate markets. The New Economy's corporate and residential space is, on one hand, globally oriented and architecturally and symbolically homogeneous, while on the other hand, it is locally oriented and strongly spatially segregated as the New Economy's elite secludes itself in exclusive, security-controlled residential and leisure-oriented communities.

This realization has lead many analysts to submit that in the digital age, attributes of place matter more than ever and that the old "location, location, location" adage still retains much value today, but only in terms of the places preferred by information industries and knowledge workers (Kotkin and De Vol 2001). In this view then, the urban form of the New Economy is determined by the live and work preferences of IT-elite workers (engineers, scientists, systems analysts, and creative people) and the strategic location decisions of New Economy firms (O'Mara 1997). Locational research shows that while high-tech companies view access to fast technological infrastructures as the *sine-qua-non* of

attractive municipalities, "quality of life" features including housing quality, easy commuting and parking, attractive urban design, and most of all, access to good educational institutions are the factors most highly rated by elite IT-employees. Thus, New Economy towns nestling university campuses and aggressive cultural amenity building programs such as "Imagine Iowa 2010," (Walker 2001) are becoming a widespread response to these preferences as states and cities vie with their national and international counterparts for global competitiveness.

New Information-Age Landscapes

Preliminary studies of places where elite IT workers congregate (Sommers et al. 2000, Kotkin and DeVol 2001) locate them in 1st tier cities like Boston, San Francisco, Manhattan and Chicago, at the edge of downtown cores in gentrifying neighborhoods or "Ciberdistricts," where telecom hotels, media software and e-com firms have tended to cluster, co-locate or relocate. Also in 2nd tier cities like Carey, North Carolina and Austin, Texas, "Nerdistans"—the sobriquet used by Kotkin and DeVol (2001) to label the campus-like research and science parks found in edge cities and exurban places—cater to the tastes of engineers, scientists, or computer analysts who trade-off big city locations for low density quiet environs in lower traffic cities. In addition, New Urbanist e-towns like Abacoa in Jupiter, Florida or Legacy Town Center in Plano, Texas; new exurban fab and tech centers like Intel's facilities at Rio Rancho, New Mexico, or Chandler, Arizona or Hillsboro, Oregon can be found in edge cities of 1st tier

cities or at the periurban edge of 2nd and 3rd tier cities. At the other extreme are the "comeback" old industrial cities like Baltimore, Central Dallas, and Dayton Ohio, that are distribution centers and have qualified blue-collar labor pools and that possess rich architectural downtowns, good public transportation and cultural activities, higher education institutions, and above all, a relative proximity to airports. The latter, according to John Kasarda (2000), appeal to firms looking for accessibility to aviation-based infrastructures. E-commerce and just-in-time supply and production chains have heighten time-base competition around the globe; consequently, cities and nations fighting cross-geographic arbitrage have combined digital technology, air commerce, and transportation logistics to gain a nodal advantage in the global lattice of information and production flows. In this game, the growth of consumer to business (B-C) commerce (e.g., Amazon, E-bay), but most notably the rise in business-to-business (B-B) activity, associated with production and supply-chain transactions, has spurred the need for speed and agility in the processing, delivery, and management of Internet-based business, and in turn, generated spatial agglomerations of distribution and e-commerce fulfillment centers near and around airports. This trend has stimulated the expansion of intelligent road freight transportation facilities leading in and out of airports and given way to a new urban form that John Kasarda calls "Aerotropolis."

Extending beyond 15 miles from the airport, the "aerotropolis is based on low density, wide lanes and fast movements" (Kasarda 2000, 3), which will soon

require dedicated express lanes for trucks and high-speed rail connecting the airport to more distant business and residential places. Although this new urban form may appear as more urban sprawl, it embodies the time-sensitive logic of the New Economy in which the 3As (accessibility, accessibility, accessibility) meaning fast and reliable digital and intermodal connectivity to airports are supplanting the 3Ls (location, location, location) as a more important real estate organizing principle (Kasarda 2000, 4). According to Kasarda, in the US large emerging aerotropoli are Washington DC's Dulles, New York's Kennedy, Chicago's Ohare, Los Angeles International, and Dallas-Fort Worth. There are also smaller specialized-air cargo centers such as Alliance Airport near Fort Worth. Internationally, Schiphol Airport in Amsterdam concentrates more than 50% of American and Japanese distribution centers and Viracopos Airport in Campinas, Brazil comprises a cluster of high-tech and logistics centers. However, the most impressive and ambitious aerotropoli are the newly built Asian technoparks and cybercities such as Media Valley near Inchon Airport in South Korea and Hong Kong's new airport in Lantau Island. These 24-hour multimodal cities are vying for global position as premier business centers in the Asian-Pacific region.

Synergies between Telecommunications and Travel

The technological restructuring of cities that displaced old industries and working class populations resulted in dual cities of rich and poor, in the casualization of work, and in the rise of temp employment. Spatial mismatch

between jobs and residence among the poor and the rise in self employed, flextime, part-time, and temp workforces (Castells 1989, 1996b; Giuliano 1998) combine with mobile telephony and the emergence of "mobile offices" to deepen the demand for road travel. One discernible effect of this transformation among some households and firms includes new surges in ex-urban location pushed in part by increased traffic gridlock resulting from more freight and automobile travel. One of the greatest ironies of the digital age is that the larger the opportunity for telecommunications to substitute for travel, the greater the demand for travel and consequently traffic gridlock. The evidence seems to indicate that telecommunications promote more surface and air travel by expanding long-distance business or personal encounters (Graham and Marvin 2000); hence, cramped roads, airplanes and airports are the synergistic outcome of IT and the automobile and airplane societies. Hence, despite the potential, yet marginal substitution effects of telecommuting (Handy and Mokhtarian 1995, Mokhtarian 1998), overall inter and intracity diffused patterns of traffic flows together with rising levels of traffic congestion and overburdened transportation facilities seem to be a manifest effect of the information-age on urban infrastructure (Hempworth and Ducatel 1992, Graham and Marvin, 1996).

Whether seen from a deconcentration perspective, which stresses the location preferences of firms and knowledge workers or from an economic restructuring perspective, which emphasizes the political economy of the global information age, the dominant spatial logic of the New Economy remains that of

peripheral dispersion with strategic re-concentration, but more so at the urban edge than in old city cores. Cyberdistricts, with their telecom hotels, clusters of e-coms, telecommuting centers, and gentrifying artsy neighborhoods, have been hailed as symptoms of an urban renaissance with the potential to re-concentrate urban activities at the core. However, the synergies between, the Internet, IT-based logistics, cellular telephony, and the automobile and airplane society, which call for fast-speed accessibility to virtual and physical places, point to a rise in demand for swift intermodalism (air, sea, and truck and rail cargo), fast mobility, reliable digital connectivity, and a tendency for increased dispersion and re-concentration of urban activities at the urban periphery of polycentric metropolitan regions. In sum, the information-age metropolis emerges as (1) polycentric and intensely extra-networked by land, air, water, and digital means to regional and urban global urban systems; and (2) deeply digitally and multimodally intranetworked, albeit all the more socioeconomically segregated, physically overextended, and stuck in traffic (Audirac 2002a).

The Information-Age Metropolis: Challenges to Smart Growth

Recognizing historically strong synergies between transportation and telecommunications, many analysts equate the IT revolution with the force for sprawl (Niles 1999). Hence, the New Economy's effects on urban form and structure may challenge, at least in three ways, Smart Growth's objectives of enhancing citizens' quality of life by reducing sprawl via incentives that direct

growth to inner neighborhoods, away from agricultural land at the urban periphery. The first challenge relates to the form and tempo of the information-age metropolis, the second to its social polarizing tendencies, and the third to the New Economy's proclivity to divert resources to new emerging digital landscapes.

The Tempo and Form of the Information Age-Metropolis

Smart Growth policies offer a better quality of life by reducing traffic gridlock through incentives for transit and pedestrian oriented communities built under New Urbanist principles. Although some potential for substituting car trips for transit trips does exist in revitalized or newly built neighborhoods under transit oriented development guidelines (Calthorpe 1993), the cumulative effect on overall metropolitan traffic patterns may not be sufficient to offset the synergistic interactions between telecommunications and road, marine, and air travel. Even Portland, Oregon's transportation planners acknowledge that metropolitan traffic patterns and congestion remain a critical problem particularly along Portland/Vancouver I-5 corridor (ODOT 2000), where current and future traffic congestion threatens the livability, timely delivery of time-sensitive goods, and the global competitiveness of the Portland/Vancouver region. The I-5 Corridor final strategic plan states that " the problems in the I-5 Corridor cannot be solved with transit, land use, and demand management actions alone. Additional capacity will need to be added to the road system to ensure that today's

accessibility and reliability can be maintained and improved" (Portland/Vancouver I-5 Transportation and Trade Partnership Task Force for the I-5 Corridor 2002, 17). If in the information age the global competitiveness of cities hinges on faster virtual and physical accessibility and quicker local and global mobility (Schafer and Victor 1997), the resulting metropolitan development patterns for business and industry are increasingly time-sensitive rather than distance-sensitive, favoring dispersed and faster traffic flows as well as faster paced urban life styles.

One of Smart Growth's biggest challenges rests on reconciling the post-industrial city's imperative for strategic economic growth and global competitiveness vis-à-vis citizens' needs for livability and sense of community—the latter understood as a return to a slower paced urban way of life. American urbanism is durable and not easily reconfigurable (Giuliano 1996). While New Urbanist communities may provide the guise or the actual form of ideal livability, by offering a mix of land uses and more pedestrian, bicycle and transit modal choice, they, together with Ciberdistricts, Nerdistans, Aereotropoli, and gated communities constitute an archipelago of information-age landscapes dispersed over large expanses of residential, commercial and industrial urbanization—the product of past technological interaction between telecommunications, transportation (De Sola Pool 1977), prevailing corporate strategic behavior, national tax and cheap oil policies (Nivola 1999), and consumer preferences. The wide dispersion of employment, shopping,

worshipping, entertainment, education, recreation, etc. over the polycentric region underscores metropolitan automobile accessibility in detriment of more environmentally friendly alternative forms of travel. Moreover, the geography of opportunity in the information age appears largely defined by fast individual mobility and digital connectivity (Shen 1999). Thus, the European style compact city, that enhances transit and pedestrian accessibility over automobility and that can ostensibly contribute to alleviate many of the environmental and socioeconomic costs attributed to American urbanism, seems to be increasingly defied by the information age (Couclelis and Getis 2000, Mitchell 2000).

Increased Social Polarization

To this day, the promise of enhancing quality of life via incentives for more livable communities that foster economic growth seems primarily oriented toward the tastes of elite IT-workers and the more affluent households. As restructuring authors often point out, the much touted vibrancy of Smart Growth communities also depends on low-wage, service temp-workers from nearby digitally deprived communities (Sassen 1991; Castells 1996a, Graham and Marvin 1996), who not only provide custodial services to businesses, but who are also the labor mainstay of the copy centers, coffee houses, franchise retail, entertainment, and other amenities valued by the New Economy and the high-end of its hour-glass occupational and income distribution. Thus, the digital

divide does not only include and affect those who lack access to digital technologies and automobility, but also such groups as working families, seniors, low-income households, and college students who are physically displaced by cyberdistricts and other gentrifying communities encouraged by Smart Growth policies seeking to revitalize inner suburbs and central cities. The shortage of quality affordable housing and mixed-income communities remain a legitimate challenge to the achievement of equitable Smart Growth communities anywhere in the U.S. (NNC 2001). Moreover, the challenge is exacerbated by the residential preferences of the New Economy's elite workers, who are attracted to amenity-rich and exclusive neighborhoods as well as by New Economy firms' locational preferences for places with state-of-the-art digital infrastructures, presence of knowledge workers, quick-response-obliging jurisdictions, and educational and culturally-rich cities (O'Mara 1997). For instance, Plano, an edge city of the Dallas-Fort Worth metro area, capitalizing on its location in the NAFTA trade region, provides fiscal incentives for logistics-based (just-in-time) manufacturing. Legacy, a 2,665-acre corporate community in Plano, is an example of the Smart Growth principle of building communities that "work smarter, not harder." Conceived as a premier business relocation hub and designed to attract high-tech elite workers, it is an information-age live-work district engineered to guarantee its corporate residents a distinctive architectural presence and spatial seclusion, but above all, security from any information-age eventuality. Legacy prominently advertises secure data communications via an impregnable fortress

of network redundancy including "a fiber-optic network large enough to encircle the world five times" (Legacy 2000). To elite knowledge workers it offers luxurious living and exciting shopping and entertainment within easy walking distance via "the first New Urbanist town center to be built within an existing business development" (Legacy 2000). In sum, Legacy and Plano, Texas typify the linking of the New Economy to the "livable community" (Henton and Walesh 1998) arduously promoted by Smart Growth advocates. However, Plano's population was characteristically 85.4% white in 1990 with a median household income 1.8 times greater than the national median.

Global Competition and Local Incentive Diverting

Although Smart Growth's economic development incentives are rightly targeted to older neighborhoods rather than outlying areas, and away from farmland and ecologically sensitive lands, national and state policies designed to stave off national and international cross-geographic arbitrage may conflict with these Smart Growth incentives and may force diversion of resources and incentives to support fringe areas and aerotropoli-like development through the typical locational subsidies (e.g., tax credits) offered to top global firms. It is often alleged that New Economy firms' locational strategies are less influenced by tax incentives than by responsive jurisdictions and good urban design (O'Mara 1997); however, the recent case of Intel's decision to forego the building of a new chip plant in Fort Worth, Texas for Chandler, Arizona—after learning

that "the Fort Worth's school district would lose state funding equivalent to any tax incentives provided to Intel" (Robertson 2000)—says otherwise.

Conclusions

Research that examines the spatial synergies involving IT, telecommunications, and transportation suggests that the emerging urban form in the digital era is increasingly more fragmented, polycentric and complex, fast dispersing and reconcentrating at the metropolitan edge, and increasingly stuck in traffic. In urban deconcentration research, locational preferences of New Economy firms and high-tech workers are the major factors explaining such outcome, while urban restructuring enquiry underscores the information-age's political economy of fast accessibility and mobility and global competition, which in turn translate into time-sensitive rather than distance-sensitive development patterns—the dominance of the "space of flows" over the "space of places." Cyber-districts, aereotropoli and New Economy towns, primarily found in amenity-rich metropolitan areas, point to new emerging information-age landscapes, whose spatial logic is based on fast and reliable multimodal and digital connectivity, with a tendency for peripheral and 2nd tier city dispersion. All in all, the above trends suggest that in the absence of effective models of regional governance and planning, the New Economy may defy Smart Growth's attempts to curb down urban sprawl, understood as more exurban development and loss of farmland and open space, social and spatial segregation, and traffic gridlock.

American newfangled digital age, as restructuring authors would submit, is characterized by downsized local governments, on one hand, and business led-coalitions operating as shadow governments on the other—"making public policy by their investment decisions" (Kanter 2000, 160). Brought together by global competition for business investment, both groups are deeply networked into private-public regional coalitions, with the luring of high-tech firms and elite-IT workers as a chief item of their economic development agenda. For some metropolitan regionalists, these new coalitions may spark a broader based grass-roots movement in support of regional initiatives such as Metro in Portland, Oregon and the Twin Cities' Metropolitan Council in Minnesota. However, lessons from California and Illinois, where the opportunity to adopt similar governance models in the 1970s was missed, show that developers and suburban interests, the groups most likely to oppose metropolitan initiatives, were strong adversaries (Weir 2000, 128). It remains to be seen whether business coalitions such as the National Town Builders Association's Smart Growth Towns initiative, which offers "alternatives to traffic congestion, long hours, cafeteria food, latch key kids, expensive housing and feelings of isolation"(NTBA 2000, 1), can achieve not only Smart Growth's quality of life objectives for consumers of New Economy Towns, but also effectively help curtail exurban expansion, traffic congestion and sociospatial segregation, or simply remain a private-public resource mobilization alliance devoted to satisfy the digital connectivity and fast

mobility demands of businesses and the live-work-play preferences of knowledge workers.

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